PSYCHE

A Journal of Entomology

Volume XXXVI

1929

EDITED BY CHARLES T. BRUES

Published by the Cambridge Entomological Club,
Bussey Institution, Forest Hills,
Boston, Mass., U. S. A.

Printed by ELIOT PRESS, 685 Centre Street, Jamaica Plain, Boston, Mass.

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https://archive.org/details/psyche_1929-03_36_1

PSYCHE

A JOURNAL OF ENTOMOLOGY

ESTABLISHED IN 1874

VOL. XXXVI MARCH, 1929 No. 1

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PSYCHE is published quarterly, the issues appearing in March, June, September, and December. Subscription price, per year, payable in advance: $2.00 to Subscribers in the United States, foreign postage, 25 cents extra, Canada 15 cents. Single copies, 65 cents.

Cheques and remittances should be addressed to Treasurer, Cambridge Entomological Club, Bussey Institution, Forest Hills, Boston 30, Mass.

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Reprints of articles may be secured by authors, if they are ordered before, or at the time proofs are received for corrections. The cost of these will be furnished by the Editor on application.

Entered as second-class mail matter at the Post Office at Boston, Mass. Acceptance for mailing at special rate of postage provided in Section 1103, Act of October 3, 1917, authorized on June 29, 1918.

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THE IDENTITY OF THE ANT GENERA GESOMYRMEX MAYR AND DIMORPHOMYRMEX ERNEST ANDRE.[1]

BY WILLIAM MORTON WHEELER

During the examination of a considerable number of ants collected by Dr. L. G. K. Kalshoven in the teak-forests of Java, I have come upon an undescribed species of Gesomyrmex, represented by a graded series of workers, all taken from a single colony and demonstrating that the singular Formicine genera Gesomyrmex and Dimorphomyrmex are synonymous. I have long surmised this identity, because there are no significant differences among the worker phases, except in the proportions of the head, eyes, clypeus, frontal carinæ and mandibles. Even the antennæ are the same and consist of only 8 joints in the worker, instead of 12, which is the number observed in the great majority of Formicidæ. But hitherto so few specimens of the two genera have been seen and the sexual forms have been so imperfectly known that no definite statements could be made in regard to their affinities.

Gesomyrmex was established sixty years ago (1868) by Mayr for a peculiar, large-eyed ant, *G. hoernesi,* which he found in the Baltic amber, of Lower Oligocene Age. In 1892 Ernest André described two extant species of ants taken by Chaper in the Kapoewas Basin, North Borneo. One of them, which he called *G. chaperi,* was evidently very closely related to the amber form; for the other, which was larger and had a much larger and more rectangular head and smaller eyes, he erected a new genus, Dimorphomyrmex. This form, *Dimorphomyrmex janeti,* he described as possessing dimorphic workers, with heads of similar structure but of different sizes. Then Emery, in 1906, discovered in the Baltic amber a form which closely resembled the Bornean *janeti* and described it as *D. theryi.* While reviewing the ants of the Baltic amber in 1913 I was able to recognize several specimens of *G. hoernesi* and *D. theryi* and two intermediate forms which I described as *G. annectens* and *D. mayri.* Two years later (1916) I described a winged female from the Island of Luzon, in the Philippines as *Dimorphomyrmex luzonensis,* and in 1921 another species, *Gesomyrmex howardi,* from a couple of workers taken by Prof. C. W. Howard near Canton, China. These workers I interpreted as major and minor workers respectively and noted that the former resembled the worker of Dimorphomyrmex. The new species from Java now shows that the specimens of *howardi* are really media and minima workers, that those of *G. hoernesi* and *chaperi,* described by Mayr and André are minimæ, that those of *D. janeti* are maximæ and mediæ of *G. chaperi,* and that the workers of *D. theryi, D. mayri* and *G. annectens* are in all probability the maximæ, large mediæ and small mediæ respectively of *G. hoernesi.* This will be clear from the following description and figures of the new species brought to light by Dr. Kalshoven.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University No. 308.

Gesomyrmex kalshoveni sp. nov.

Worker maxima. (Fig. 1, a-d) Length 5-6.6 mm.

Head subrectangular, about 1 1/4 times as long as broad, slightly narrower in front than behind, with the sides distinctly concave in front of the middle; the posterior border feebly concave, the posterior corners convex and rounded; the dorsal and gular surfaces rather flat. Eyes elongate, convex, scarcely reniform, with straight or very nearly straight internal and impressed posterior orbits, one-third as long as the head and well up on its dorsal surface. Ocelli minute, unpigmented, the anterior smaller than the two posterior, which are on a level with the posterior orbits of the eyes. Mandibles stout, convex, with strongly rounded external borders, 8-toothed, the first, second, fourth, sixth and eighth tooth, counting from the apex, larger than the others and rather blunt. Clypeus short and flat, its anterior

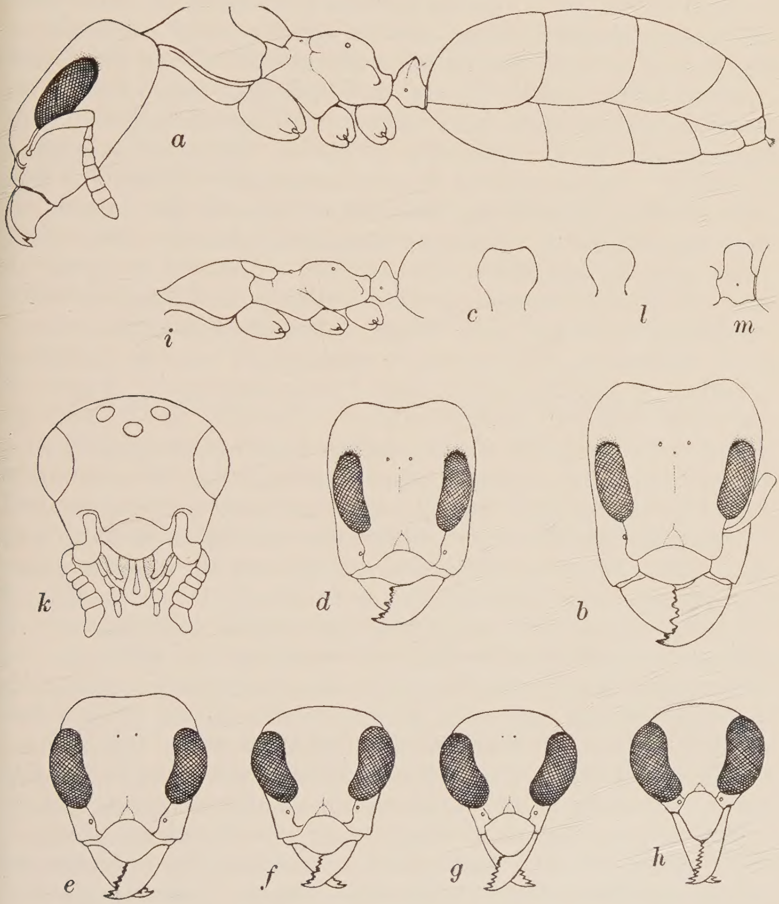

Fig. 1. *a. Gesomyrmex kalshoveni* sp. nov. Maxima worker in profile; *b.* head of same; *c.* petiole from front; *d.* head of small maxima; *e.* head of large media; *f.* of small media; *g.* of large minima; *h.* of small minima; *i.* thorax and petiole of same; *k.* head of male semipupa; *l.* petiole of *G. howardi* Wheeler from front; *m.* same in profile.

border slightly and evenly rounded, scarcely projecting in the middle; its lateral portions not reaching the anterior corners of the head, convex but not auriculate. Frontal area distinct, moderately large and triangular; only a portion of the frontal groove developed in the middle of the head just anterior to the ocelli; frontal carinæ widely separated, subparallel, rather erect and slightly lobular anteriorly, continued back to the anterior orbits of the eyes. Antennæ 8-jointed; scapes curved basally, gradually thickened distally, their tips reaching somewhat beyond the middle of the eyes; funiculi distinctly enlarged apically, first joint twice as long as broad; second and third 1 1/2 times as long as broad, remaining joints nearly as broad as long, except the terminal joint which is somewhat longer. Thorax stout anteriorly, the pro- and mesonotum convex, forming together a hemispherical mass, separated by a distinctly impressed suture, rounded above in profile, the former as broad as long with a faint median longitudinal impression behind; the latter as long as broad, subcircular with straight posterior and rather deeply impressed anterior and lateral sutures. Behind the mesonotum the thorax is divided into two regions by a transverse dorsal furrow; the shorter anterior portion, representing the metanotum is depressed and bears the somewhat projecting metanotal spiracles at its sides; the posterior portion, representing the epinotum, is as broad as long, with the base somewhat convex and bearing the epinotal spiracles at the middle of its sides. Posteriorly it passes into the distinctly shorter, sloping declivity, with which it forms a distinct, obtuse angle. Petiole small; its node from above transversely elliptical, nearly 1 2/3 times as broad as long; in profile distinctly cuneate, with convex anterior and posterior surfaces, the moderately sharp superior border transverse, feebly and broadly excised or sinuate in the middle. Gaster large, elongate-elliptical. Legs stout; all the femora somewhat thickened; spurs of middle and hind tibiæ very short; tarsal claws large and stout.

Smooth and shining; mandibles coarsely punctate, with a few incomplete longitudinal rugules; head more finely punctate; median portion of clypeus, front and cheeks finely and longitudinally striate as far back as the eyes.

Thorax, petiole, gaster and appendages very minutely and sparsely punctate, the gaster also very delicately and indistinctly, transversely coriaceous.

Hairs yellowish white, absent on the body, except at the tip of the gaster and on the mandibles, clypeus and front. On these latter regions they are numerous, short, erect, stubby and obtuse. Scapes with short oblique hairs. Pubescence undeveloped, except on the tibiæ where it is very short, dilute and appressed.

Honey yellow; gaster and legs paler and more whitish yellow, the several gastric segments very faintly infuscated posteriorly; frontal carinæ and mandibles red, the latter with black teeth and dental border; impressions of the posterior orbits dark brown; claws and tarsal articulations reddish.

Worker media. (Fig. 1 e and f) Length 3.5-4.5 mm.

Differing from the maxima mainly in the characters of the head, which is proportionately smaller and only 1 1/6 to 1 1/5 times as long as broad; its posterior portion shorter and more rounded, its anterior portion more narrowed, with proportionally larger eyes, which are more convex, and reniform, i.e. with concave internal orbits and one half as long as the sides of the head. Posterior ocelli represented by minute pits in the larger, usually absent in the smaller specimens. Mandibles 7-8 toothed and more elongate and less convex than in the maxima, with less convex external borders and only the first, fourth and fifth tooth enlarged and more acute, the third, seventh and eighth very minute. Median portion of the clypeus longer, more convex posteriorly, its anterior portion more advanced and lobular, depressed. All the funicular joints longer than broad, except the penultimate. Thorax somewhat more slender than in the maxima, pronotum without longitudinal impression; mesonotum longer than broad, with more nearly parallel sides; its surface flattened and even slightly concave in profile. Petiole as in the maxima, but slightly more narrowed above.

In the larger media there are distinct striæ and short stubby hairs on the front, though the latter are less numerous; in the small media these hairs are absent and the striæ are very indistinct or obsolete. Color like that of the maxima, except that the mandibles are yellowish, with only the teeth blackish.

Worker minima. (Fig. 1 g-i) Length 2.8-3.2 mm.

Differing from the media in having a still shorter head, in the smallest minima scarcely longer than broad including the eyes, which are more convex and laterally projecting, decidedly reniform and taking up more than 3/4 of the sides of the head, so that the cheeks and postocular regions are greatly reduced, the latter without distinct corners and with slightly and evenly convex median border. Clypeus much longer and anteriorly projecting, more convex behind and somewhat more concave in front, than in the media. Ocelli represented by a pair of very minute pits or completely absent. Mandibles more elongate, flattened, with straight external borders, the teeth forming a more even crowded series, the apical longer than the basal. Frontal carinæ very short and indistinct. Antennal scapes extending to the posterior third or fourth of the eyes. Thorax more slender, pro- and mesonotum much less convex, with nearly straight outlines in profile, the latter feebly concave as in the media. Legs slender, but with the femora distinctly enlarged basally.

Mandibles pale yellow with reddish teeth; posterior orbits not tinged with brown. In other respects like the small media. The larger minima is intermediate between the small minima and the small media even in the structure of the mandibular teeth.

Described from 15 workers taken by Dr. L. G. K. Kalshoven in a teak-forest at Semarang, Java. The following are the lengths of the individual (alcoholic) specimens:

Maximæ: 6.6 mm.; 5:7 mm.; 5.3 mm.; 5 mm.

Mediæ: 4.5 mm.; 4 mm.; 4 mm.; 4 mm.; 3.8 mm.; 3.8 mm.; 3.5 mm.; 3.5 m.m.

Minimæ: 3.2 mm.; 3 mm.; 2.8 mm.

The variations in structure in all the castes are so finely graduated that there is no hiatus between the smallest specimen measuring 2.8 mm. and the largest measuring 6.6 mm.

G. kalshoveni must be very close to the form described by André as *G. chaperi* from the minima and "*D. janeti*" from the maxima and media worker. He gives the length of the minima as 3.5 to 4 mm., of the media as 3.5 mm. and the soldier as 6 mm. If his descriptions were drawn from cabinet specimens the fact that the largest minima was longer than the media may be explained on the supposition that the gasters of the two specimens had contracted unequally on drying. Such differences are, of course, frequent also in the gasters of living or alcoholic specimens of the same caste, owing to variable distension of the crop. The maxima of *kalshoveni* differs from that of *chaperi* in lacking the lateral auriculate expansions of the clypeus, in possessing longer funicular joints and nonpigmented ocelli, a decidedly more convex pronotum and in having the stubby hairs on the front and clypeus simple and truncate instead of bifid or multifid at their tips. André describes these hairs as "appearing as if surmounted or even crowned with minute spines." Emery has cited *G. chaperi* (as *D. janeti*) from Sumatra, but it is not improbable that his specimens belonged to the Javan rather than to the Bornean species.

The new Gesomyrmex differs from *G. howardi* in the shape of the petiolar node, which in the latter (Fig. 1, l and m) is much thicker above, with rounded, entire border, in the epinotum which is shorter in *howardi,* with much less convex base and with the base and declivity subequal. The sculpture of *howardi* is decidedly coarser, especially on the epinotum and pleuræ, so that the surface is more opaque. The color is also darker and more brownish or sordid than in *kalshoveni* and *chaperi.* There are distinct striæ on the front in the media and minima of *howardi.* It is, of course, not improbable that all four living species of Gesomyrmex, including *G. luzonensis,* which is known only from the female, may prove to be merely so many local races (sub-species or varieties), when sufficient material of these forms has found its way into our collections.

It would be interesting to revise the fossil species of Gesomyrmex in the light of the preceding discussion. Of the material which I studied in 1913 and soon afterward returned to the Königsberg museums, I retained only a single block of amber containing a large and a small worker of "*D.*

theryi" side by side and designated as K. 6397, in my paper on the "Ants of the Baltic Amber" (1914). The large worker, which measures fully 7.5 mm., is very clear, but the head of the small worker, which measures only 4 mm., is obscured by a film and some bubbles of air. I have now had the block cut down and repolished, so that the head of the small individual is more clearly visible. It proves to belong to the form which I called *D. mayri,* and is really a media of the same species as the large (maxima) worker. The latter has small but very distinct ocelli, but none can be detected in the companion specimen. Since *G. annectens* is clearly intermediate between *D. mayri* and *G. hoernesi,* the former is, in all probability the large minima, whereas the latter represents the small minima of Mayr's species. I am, therefore, of the opinion that all the specimens of Dimorphomyrmex and Gesomyrmex in the Baltic amber belong to a single polymorphic species, which should be known as *G. hoernesi* Mayr.[1] This is of considerable interest, because it shows that as far back as the Lower Oligocene one Formicine ant had not only reached a high degree of specialization in the reduction of the number of antennal joints of the worker from 12 to 8, but that this caste had become as polymorphic as it is in the living species of the genus now confined to Indonesia and Southern China. And conversely, the very rare and sporadic occurrence of these forms shows that they are really living fossils which have undergone no significant modification since the Early Tertiary.

The workers collected by Dr. Kalshoven were accompanied by several milk-white larvæ of different sizes and a single semipupa. The larvæ resemble those of other Formicinæ in shape, but are almost hairless. The head is very small and subglobular, the mandibles minute, with only an apical tooth, which is drawn out into a slender, acute point. The semipupa measures a little over 7 mm. and is not enclosed in a cocoon. We must infer, therefore, that the pupæ of Gesomyrmex are naked as in a few other genera of Formicinæ. (Œcophylla, Prenolepis, Paratrechina). The semipupa is clearly a male. It has well-developed wing-pads and rudiments of the genital valves, and the imaginal head (Fig. 1, k) is sufficiently developed to enable me to determine its main peculiarities. As will be seen from the figure, it is broader than long, with evenly rounded, convex, postocular region; the eyes are very small, for a male, not longer than the cheeks, not very convex and situated at the sides of the head; the ocelli are moderately large but flat; the antennal insertions are very far apart and near the anterior orbits; the antennal scapes are short and abruptly bent outwards at their tips (probably a pupal character), the funiculi short, thick and distinctly 6-jointed (!), instead of 7-jointed as in the worker; the clypeus is rounded and slightly projecting in the middle; the mandibles small, narrow, edentate and rather blunt. The specimen is of considerable interest because no other male of the genus is known, though Mayr carefully described and figured what he took to be the male of *G. hoernesi* from a rather poorly preserved specimen in the Baltic amber. Although we must allow in my description of the male semipupa of *G. kalshoveni* for later pupal changes (especially, perhaps, in the number of funicular joints), it is clear, nevertheless, that the male of this species is decidedly different from Mayr's specimen. This has enormous eyes, constituting the greater portion of the head, very minute pointed mandibles, very slender 11-jointed antennæ and very minute genital appendages. Although the wing-venation agrees closely with that of the female *G. luzonensis*, I believe that Mayr's specimen must belong to some other hitherto unidentified Formicine genus.

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[1] Compare my figures 50-53 in "The Ants of the Baltic Amber."

Two other fossil ants supposed to be allied to Gesomyrmex may be briefly considered in this connection. The first of these is a large-eyed worker which Emery described from the Sicilian amber of Miocene age, as *Gesomyrmex corniger*. His description and figures, however, show that this insect cannot be included in the genus Gesomyrmex. The shape of its head, mandibles and petiole, the presence of long oblique spines on the epinotum, the very long maxillary palpi, the abundant pilosity, peculiar rugosity of the head, pro-and mesonotum, the blackish coloration and the possibility that its antennæ may be really 9 or 10 instead of 8-jointed, led me to place it in a distinct genus, Sicelomyrmex. Apart from the peculiar recurved horns at its posterior corners, the head of this ant is more suggestive of the Neotropical

Gigantiops and the Congolese Santschiella than of Gesomyrmex. The other ant is *Prodimorphomyrmex primigenius* which I described from the Baltic amber. It approaches Gesomyrmex much more closely, but has smaller eyes, 10-jointed antennæ and a shorter thorax. Only a single imperfect specimen was observed.

The following would now be the corrected synonymy of the known species of the genera I have been considering:

Living Species

Gesomyrmex chaperi Ern. André. Borneo, Sumatra.

Gesomyrmex chaperi Ern. André, Mém. Soc. Zool. France 5, 1892 p. 47, Figs. 1-3, worker minima; Emery, Gen. Insect. Formicinæ 1925, p. 47, Pl. 2 Fig. 3, worker media.

Dimorphomyrmex janeti Ern. André, Mém. Soc. Zool. France 5, p. 51 Figs. 4 and 5; worker maxima and media.; Emery, Ann. Soc. Ent. Belg. 43, 1894, p. 494, worker maxima.; Emery, Gen. Insect. Formicinæ 1925, p. 47, worker maxima and media.

Gesomyrmex luzonensis (Wheeler). Philippines.

Dimorphomyrmex luzonensis Wheeler, Proc. New England Zool. Club. 6, 1916 p. 16, Fig. 4, female; Emery, Gen. Insect. Formicinæ 1925, p. 47, female.

Gesomyrmex howardi Wheeler. China.

Gesomyrmex howardi Wheeler, Psyche 28, 1921 Fig. 2, worker media and minima; Emery, Gen. Insect. Formicinæ 1925, p. 47, worker media and minima.

Gesomyrmex kalshoveni Wheeler. Java.

Described above p. 2 from the maxima, media and minima worker and male semipupa.

Extinct Species.

Gesomyrmex hoernesi Mayr. Baltic Amber.

Gesomyrmex hoernesi Mayr, Beitr. Naturk. Preuss. 1, 1868 p. 52, Fig. 38 to 41, worker minima; not the male; Dalla Torre, Catalog. Hymen. 7, 1893 p. 176; Ern. André, Bull. Soc. Zool. France 20, 1895 p. 82; Handlirsch, Foss. Insekt. 1908 p. 859; Wheeler, Ants, etc. 1910 p. 170, Fig. 100; Wheeler, Schrift. physikal-ökonom. Gesell. Königsberg 55, 1914, p. 108, Fig. 53, worker minima.

Dimorphomyrmex theryi Emery, Bull. Soc. Ent. France 1905 p. 188 Fig. 1, worker maxima; Handlirsch Foss. Insekt. 1908 p. 868, worker maxima; Wheeler, Ants, etc. 1910 p. 173, Fig. 98, worker maxima; Wheeler, Psyche 17, 1910 p. 132; Wheeler, Schrift. physical-ökonom. Gesell. Königsberg 55, 1914, p. 104, Fig. 50, worker maxima.

Dimorphomyrmex mayri Wheeler, *ibid.* p. 106, Fig. 51, worker media (large).

Gesomyrmex annectens Wheeler, *ibid.* p. 107, Fig. 52, worker media (small).

Prodimorphomyrmex primigenius Wheeler. Baltic amber.

Prodimorphomyrmex primigenius Wheeler, Schrift. physikal-ökonom. Gesell. Königsberg 55, 1914, p. 112, Fig. 54, worker.

Sicelomyrmex corniger (Emery) Sicilian amber.

Gesomyrmex corniger Emery, Mem. Ist. Bologna (5) 1, 1891, p. 581, Figs. 33-35, worker; Wheeler, Ants, etc. 1910, Fig. 101, worker.

Sicelomyrmex corniger Wheeler, Schrift. physikal-ökonom. Gesell. Königsberg 55, 1914, p. 111, worker; Wheeler, The Social Insects, etc., 1928, Fig. 27, worker.

The affinities of Gesomyrmex and Dimorphomyrmex to other Formicine genera have been discussed by Forel and Emery. In his revision of the subfamily Formicinæ (1925), Emery places the two genera in his sixth tribe, or first tribe of the section Euformicinæ, which he bases on characters drawn from the gizzard (proventriculus). Unfortunately, he named this tribe Dimorphomyrmicini (his Dimorphomyrmii of 1895). Since the genus Dimorphomyrmex now passes into the synonymy, the tribe will have to be called Gesomyrmicini (Ashmead, 1905). This tribe, according to Emery, would contain besides Gesomyrmex only the genera Brachymyrmex, Aphomomyrmex and Cladomyrma. The three latter are supposed to be so closely interrelated that they form together the subtribe Brachymyrmicini, leaving Gesomyrmex to represent a subtribe by itself, to which Emery gave the same name as the tribe (Dimorphomyrmicini). He evidently based his tribe on the small number of antennal joints (8-9 in the worker, 8-10 in the female) instead of the 12 observed in both of these castes in all Euformicine genera, except certain fossils (Dryomyrmex and Prodimorphomyrmex). But the general habitus of Gesomyrmex is so different from that of Brachymyrmex, Aphomomyrmex and Cladomyrma, that its relationships would seem to be better expressed by regarding it as the representative of an independent tribe (Gesomyrmicini). This would necessitate raising Emery's subtribe Brachymyrmicini to tribal rank. I believe that the tribe Gesomyrmicini would thus be more naturally placed as one of the series of tribes, including the Santschiellini Forel, Gigantiopini Ashmead and Œcophyllini Ashmead, which are all based on single archaic, relict genera of large-eyed ants. The fossils Prodimorphomyrmex and Dryomyrmex may, perhaps, be assigned to the Brachymyrmicini, but *Sicelomyrmex corniger* should be regarded as the representative of an extinct tribe, the Sicelomyrmicini.

We are still in the dark in regard to the habits of Gesomyrmex. The well-developed claws in the worker and female and the not infrequent occurrence of *G. hoernesi* in the Baltic amber, suggest that the genus is arboreal. Moreover, the structure and sculpture of the anterior portion of the head in the maxima and female and the peculiar stubby hairs on the clypeus are reminiscent of some species of Colobopsis and allied subgenera of Camponotus, which live in hollow twigs or small cavities in bark or wood.

PRESENT TRENDS IN SYSTEMATIC ENTOMOLOGY.[1]
GENERAL DISCUSSION.

By Charles T. Brues,

Bussey Institution, Harvard University.

When I was asked recently to address a group of entomologists on the present activities in taxonomic entomology, I had grave doubts that the tendencies evident in the work of this large but frequently despised group of zoologists would be of any interest to students of insects in other fields, or even to the taxonomists themselves. The latter expectation seemed especially probable as systematists have become quite callous to derogatory remarks from biologists not versed in taxonomy, and have tended to lapse into a condition of *laissez faire* with reference to the relations of taxonomy to the other branches of zoology. Also I can by no means lay claim to that broad familiarity with insect taxonomy which should be expected of one who essays to outline its tendencies. Nevertheless there is some advantage in viewing such matters after frequent visits into other fields, for every return brings a new series of impressions which serve to throw into relief the changes that are gradually taking place.

Systematic entomology is growing old, and like a living organism it exhibits the usual signs of age in the development of fixed eccentricities of behavior. Fortunately for the ultimate progress of biology it has not persisted as a single entity, for it has produced during its long lifetime a series of distinguished, but not always harmonious offspring. These are now so vigorous and some of them so self-satisfied that they occasionally betray their disapproval of the motives and accomplishments of the other members of the family. At the present stage of our science their actions would seem to presage a lively future for entomology as younger and less strongly inhibited generations come into being.

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[1] This and the paper that follows were presented as part of a symposium at the annual meeting of the Entomological Society of America in New York City, Dec. 27, 1928.

Like the poor old overworked phylogenetic tree of life, systematic entomology has developed many branches, each of which engages the attention of a series of zealous searchers for truth. Its growth has been purely spontaneous, and it has so far suffered few serious setbacks. For some millions of years Nature has pruned the phylogenetic tree until any second-rate gardener would shudder at its appearance. Decadent branches have been ruthlessly lopped off without respect to symmetry, age or prestige. Its twigs have developed millions of bud variations; it is enveloped in a tangled mass of parasitic vines and further beset with galls, excrescenses, and tumors. If it were anything more than a convenient diagram for evolutionary progress, it must have needs long since crashed to the ground. Its more ancient aerial parts have literally crumbled to the earth for we now find bits of them preserved as fossil remnants. These are being slowly reclaimed and furnish the setting for an historical background. At the present time the primary basis of systematic entomology consists of the greater part of a thin horizontal section through this tree at its upper level—the living insect fauna. It appears as a hopelessly complicated mass of details; nevertheless we know that its ten million species form no haphazard assemblage, but that they exist as an integrated whole, so thoroughly integrated in fact, with reference to its component parts, to other living organisms and to physio-chemical conditions that we stand at present utterly helpless before it, unable to analyze the smallest part of its complicated structure.

As personalities tend to become similar after long association, entomologists might be expected to become so thoroughly integrated in their work that they could enter this biological maze with understanding. That would be the millennium. We may justly ask if systematic entomology as represented by its many adherents is entering upon a stage where it will pave the way, through an understanding of the taxonomic affinities of insects, for entomologists as a whole to fathom their biological interrelationships. In other words, are the present trends of systematic entomology leading to this goal which represents the biological Mecca?

I am fully aware that the present Mecca of many biologists lies in quite another direction—in the reduction of the phenomena of life to physics, chemistry and mathematics, but am not willing to concede that this will prove to be either the final goal, or the methodology which will lead to it.

This attitude has arisen through the more or less tacit assumption that biology will finally find its place among the exact or mathematical sciences. This is regarded by the systematic biologist as a wholly undesirable if not impossible attainment. They have already cast aside any substitution of numerical notation and symbols for binomial names and higher groups, as in no way simplifying the expression of taxonomic relationships. The reactions of organisms to light and heat, their growth and metabolism, the interactions of their genes in inheritance and many other phenomena which are due to similarities of their make-up are capable of mathematical expression as entities, so perhaps might be the combinations and permutations of these. Evolutionary change which is of primary importance to systematics and phylogenetics on account of its historical aspect is a process of differentiation, recombination or emergence, and to believe that this has proceeded upon uniform or predictable lines does not aid in organizing the mass of data which taxonomy has so far accumulated.

To observe the way in which one is viewed by his colleagues is generally a fair method of discovering one's shortcomings and it may sometimes even lead us to discover our virtues. In either case it aids in the development of the submissive spirit which is a formidable asset in approaching the altar of Nature. As taxonomy is the oldest branch of natural history we may regard the newer branches as younger brothers and sisters whose criticisms are tinged with juvenile jealousy and largely to be discounted. Of these younger branches morphology is the first child of taxonomy; indeed she is already becoming so Victorian in the eyes of the rising generation, that I hesitate to be seen smiling at her in public. Comparative morphology may be regarded either as the tool of taxonomy, or as a by-product of the latter; unfortunately it is sometimes pursued independently which greatly limits its field of usefulness. Many of the contacts of systematic entomology with morphology relate to matters of nomenclature and these are perhaps the most unfortunate ones. The majority of morphologists hold the idea that the present instability in nomenclature as it relates to generic names is a disgrace which entomologists may be expected immediately to remedy. Most entomologists agree with them heartily and some have offered to supply remedies. As the affliction becomes chronic, many kind friends suggest new remedies and we are urged to learn by trial and error the benefits of each. At the present time we are powerless to stem the rising tide of names resurrected from oblivion by a few industrious searchers who follow this pursuit as a pastime or mental discipline during their leisure hours. By the rediscovery of some long-forgotten pamphlet it is possible with very little effort to cause an uproar whose echoes ring for many years. When a series of such commotions in rapid succession fails to drown out the small voice of the non-combatants who believe that the face of Nature is being changed too rapidly, deeply pitched cerebrations on the part of others bring forth new interpretations of previous literary researches, and so far as we can foresee, this process may go on forever. At the present time almost no branch of systematic entomology is free from this incubus and it is difficult to view with equanimity the future of entomological nomenclature, in spite of the protestations of those who insist that they are submerging their personalities for the good of science. There is of course some hope that the International Commission on Zoological Nomenclature may be able to restore order. They are struggling valiantly toward that end, but they need good honest support. I think that most of us are willing to give this, both actively and passively. The latter is particularly easy for it saves vast quantities of energy, breath and printer's ink, all of which find a ready market for other purposes. Perhaps no group of entomologists have suffered so long and painfully from nomenclatorial unrest as the lepidopterists[1] but their colleagues in other fields are facing the rapid approach of an equally distressing situation.

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[1] Dr. Forbes' discussion on a later page (p. 21) of the present issue of Psyche deals in an admirable way with this question.

Another criticism of systematic entomology that comes from the morphologists is that we do not take their work sufficiently into account as a basis of classification, and some have even gone so far as to elaborate new classifications of their own. Their contention does not seem to be well founded and a canvass of the present situation in this regard seems to justify the statement that never before have taxonomists (with a few notable exceptions) been so keen in their treatment of characters for the limitation of higher groups and in attempting to indicate phylogenetic relationships. Only those who have labored thus to bring order out of chaos appreciate (to borrow a very self-satisfying political expression) the "intricate complexity" of modern taxonomy, which by the way has the science of government skinned a mile when it comes to complexity. This very fact has developed another trend which is the continuous movement toward great specialization among taxonomists. Its necessity and advantages are obvious, but its drawbacks are very serious and unfortunately not always appreciated by the individual worker. There are at present really two types of specialists in taxonomy. One may be considered to include those who early acquired a general knowledge of insects and later settled upon some particular group to which they have devoted their energies. The other class includes those who have very early undertaken to specialize on a small group. The latter series is made up mainly of college students who have been assigned to taxonomic problem by some indulgent professor who hopes that he may rapidly impart to them the general familiarity with insects that he has acquired from long and tedious experience. Incidentally he knows that it will keep them busy. This method is not always entirely successful since it frequently develops such enthusiasm that all other fields of general value to taxonomists may be neglected. This class of workers has been rapidly augmented during recent years by the great urge to enter early into productive research, a condition which prevails in all departments of biology alike. It is fostered by marked changes which are occurring in our colleges and universities and particularly by the many luscious plums that are dangled before the noses of prospective research workers in the form of research endowments and fellowships. From the many temptations toward too early specialization systematic entomology suffers more severely than the more recently developed branches since its literature has grown to be far more extensive and the details with which it deals are not only more varied but more complex as, they do not appear to be reducible to simplified expression or generalization. Can we say that we are honestly giving these problems the attention they require in the training of taxonomists?

The contributions of genetics are providing a great amount of material which is of broad importance to systematic entomology and this is gradually being utilized by taxonomists to broaden their ideas concerning specific relationships, veriability, polymorphism, etc. Genetics sometimes complains that taxonomy should make wider use of its methods and discoveries. We can only reply that we hope to do so more fully in the future after we have again corralled all the insects that Noah let loose on Mount Ararat, together with any new species, hybrids and mutations that may have come into being since that time. Certainly the discoveries of genetics have already greatly modified the taxonomic treatment of species and intraspecific forms, but so far it has been impossible to utilize them to modify the current methods of comparative morphology in dealing with larger groups.

One present trend of systematic entomology is difficult to see in a clear light. Physiology, together with its child ecology, which is really a nursery of young children not yet quite capable of socializing their behavior, is a department of biology whose methods and outlook are rapidly changing. So far the contacts of physiology and ecology with taxonomic entomologists have been few and mainly confined to the utilization of the taxonomic laboratory as a workshop where trained mechanics could repair and get into understandable form certain lists of names representing the materials investigated by biologists to whom taxonomy and nomenclature is a totally unknown, thickly populated, but nevertheless utterly barren field. Fortunately, through the intervention of ecology it appears that physiology and taxonomy have come to regard each other with greater respect and there are indications that taxonomy may in the future greatly profit by the investigations of her co-workers in physiology, who in turn would not suffer any great degradation from a slight knowledge of systematics.

Taxonomy and phylogenetics are of course so inseparably united that it is impossible to deal with any aspect of one without considering the other. The structure of the phylogenetic tree is such that it brings into taxonomy a fourth dimension which is difficult to deal with nomenclatorially at least. This condition is by no means restricted to entomology, but as we shall see in a moment it promises to become more acute with insects than with other groups of animals. The development of insect paleontology has until quite recently been very slow and restricted to a small series of fossil forms, most of them comparatively recent and some of the others dating back to what appears to be the earlier pages of entomological history. Naturally most of these ancient forms are more or less annectant between modern orders, and have been grouped taxonomically as a very generalized extinct order, Palaeodictyoptera. The recent discovery of undoubted precursors of particular living orders or families and a vast series of genera and species before the mesozoic indicates that very soon we shall have numerous annectant forms between families and even orders that will form a number of taxonomic anomalies. Moreover many of the Persian fossil insects are so well preserved that their relationships may be very accurately determined. So far these fossil forms have generally been placed in separate orders, families and genera, but as these rapidly multiply and overlap one another they will produce an intolerable condition in the nomenclature of higher groups. This is more especially true as some groups have persisted over long geological periods while others have undergone a much more rapid evolution. It is also evident from studies of the beautifully preserved insects of early Tertiary age in Baltic amber that the same difficulty is arising here among the genera of the more recent groups of insects. Some entomologists still cling to the idea that fossil insects can be dealt with as a series apart. Naturally we can deal separately with a Permian and an Oligocene fauna but we cannot regard them taxonomically or nomenclatorially as any more independent than the present day faunas of New England and Italy.

An entirely different aspect of systematic entomology that has advanced by rapid strides during the last few years is our knowledge or the preparatory stages of insects. A number of very successful attempts have been made to deal taxonomically with the larval stages of diverse groups; many Lepidoptera, Diptera, Hymenoptera, Coleoptera and Trichoptera have been studied with great care and if the human race persists long enough this task will increase until it becomes larger and undoubtedly more difficult than that presented by imaginal insects. So far it has corroborated many of the conclusions reached from taxonomic studies on adult insects and has served to give us faith in the principles of entomological classification. Considering, as we have said, the intricate complexity of the insect fauna, entomologists can point with pride to their accomplishments during the past 70 years of the post-Darwinian regime; and that is one very good reason why none of us wishes to return to the fundamentalist doctrine that we can never understand organic relationships. It must be admitted that some scandalous discrepancies as well as many minor errors of judgment have been exposed by this work on the preparatory stages, and these are proving a great aid toward clarifying systematics in various groups, especially those where characters of dubious validity have been widely used.

Throughout all the most recent work in systematic entomology there is a most pronounced tendency toward great specialization, and a growing worship of the species and the type specimen. The former is nurtured as we have said by the desire to enter very early into productive research, and the latter is fostered most assiduously by the modern museum curator. There is also evidence on every side that systematics is being systematized and standardized, just as business, teaching, manufacture and every other human activity has been mechanized at the hands of the efficiency expert. The last has been lately transmuted into the administrator or popularly as the modern executive. So far few entomologists have fallen under this spell, for most of them are more interested in their work than in aspirations to the mahogany desks, telephones and the other furnishings that are prerequisites of such a job. Some of them at least may be trusted to remain as free lances who are ready to drop an occasional fly or other specimen in the entomological cream as it emerges in a velvety stream from the systematic separator. It is only such behavior that will prevent a too great uniformity in our product.

PRESENT TRENDS IN SYSTEMATIC ENTOMOLOGY. SCIENTIFIC NAMES.[1]

By Wm. T. M. Forbes

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Of the several millions of kinds of plants and animals in the world, there are some hundreds that any one of us may wish casually to refer to. These have received "common" names and if they alone existed, scientific names would be unnecessary. My present concern is only with the remaining millions. How shall we tag each one of those millions so that on the rare occasion when one of us must mention it to another we can make ourselves understood?

In ancient times the problem was hardly visualized. The hundreds received each a name. Any other creature was a "creeping thing after his kind." In the next stage, the idea "his kind" was represented in some way and we have the beginning of our scientific scheme. At this stage we have a name—a group name—that any one can understand, and the distinguishing word or words that mark a single member of that group:—a butterfly, "Papilio" and *that brown* butterfly, "Papilio fuscus," or the particular brown one with eyespots, "Papilio fuscus ocellatus."[2]

Linnæus began with this plan, which had grown up gradually, and took a step further. Instead of a series of adjectives he chose—arbitrarily—one single word to designate a particular kind of butterfly. He did it casually, it was just a convenient tag,—a *nomen triviale.* And with this step the present cycle begins. That "trivial name" was so convenient that it overshadows our whole system of names. The oldest name (the common name) was known to all and needed no rules; the second type was descriptive, at least in rudiment, and took care of itself, but the new "trivial" kind was arbitrary; it carried no meaning in itself, but only by agreement; so it was necessary to find a basis of agreement.

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[1] See footnote on page 11 of this issue.
[2] My examples are imaginary.

There are three bases of agreement:—

AUTHORITY
PRIORITY
JUDGMENT

The assignment of names may be put in the hands of some *Authority*. During Linnæus's life, by a sort of general consent he was recognized as the Authority: when he used a name that name stood, when he saw fit to change it, the world changed too. And when Linnæus died, his successor, Fabricius, stepped into his place (I am speaking of entomology). Fabricius seems to have claimed this mantle of authority, but it was not unanimously conceded to him, and as disputed authority without power is no authority, this policy fell into abeyance until the formation of our International Commission.

The second obvious plan was *Priority*. Let the oldest name rule, beginning with the book in which Linnæus first proposed this scheme of things.[1] This sounds excellent, but complications soon arose. Let us consider merely the "trivial name." Two workers recognize or discover a species about the same time in different countries. Each gives it a trivial name, and each name gets currency in its own country before it is recognized that both are the same creature. Then the question is raised: Which is prior? If there is doubt, and there well may be, each country favors its own worker, and we have two or more rival names.

At the time that Fabricius retired from the field we have a further complicating factor that *we* can appreciate better than the last generation. That was the time of the Napoleonic wars, and literature did not always travel freely. Also there was a nationalism that interfered with the application of the law of priority when a national difference of usage appeared. We have one outstanding case in the Lepidoptera, where all these difficulties fell together—Hübner. Hübner was a rival of the authority of Fabricius; his works were irregularly used and carelessly dated if at all; and he was publishing in Germany at a time when it was cut off from France.[1] As a result names he gave have been a bone of contention from the beginning. And from the beginning there has been a tendency to give the other party the benefit of the doubt, whenever there was any uncertainty of priority of date.

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[1] For a long period the tendency was to reserve Linnæus' own authority, and begin the rule of priority at the point where Linnæus laid it down.

Now appears the third policy, *Judgment*. From this period of confusion and for a century more, most authors gave up hope of agreement on any *authority*, or of any certainty of *priority*, and merely used the name they thought most likely to be correctly understood by their readers.

So much for the "trivial" name.

Next is the genus; in this case we have all the factors we have been displaying in the matter of the trivial name, affecting the name as a *name*; and superposed on this we have a second, confusing factor. Besides *nomenclature*, we have *classification*. At first the genus name was merely the vernacular (Latin) name, familiar to every one who read Latin. Every butterfly was Papilio, every moth, Phalæna. But even in Linnæus' time it seemed necessary to divide this mass, for instance to have a name by which we could tag all the "four-footed" butterflies; and there gradually came, with an emphasis on more and more abstruse characters a steady subdivision of the original genus.

This raised the question: when you divide a genus, which part takes the old name, and which gets the new one? Here we have two choices,—or three. We may try in one way or another to find which the original author thought most characteristic of his name, and center our new group about that species (the type), or we may leave it to the man who divides the genus to use his judgment. There is a third method, largely used, I believe by ichthyologists, but also by a few entomologists—to cut the Gordian Knot, and arbitrarily choose the species the author happened to mention first. Some would qualify this choice in one way or another; a few have applied it even where the author expressly says his first species is not typical, or where his first species, in contrast to others, violates his definition.

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[1] My friend Benjamin finds his "Tentamen" (issued in 1806) was used or referred to in practically every country but France.

Our present code orders us to use the type method. For the past half century the other two methods were almost consistently in vogue. And this change—in origin a compromise between these two in themselves wholly contradictory methods—is the basis of a large proportion of the recent violent shifts in names.

The code supplies a nominal loophole in the "conservanda principle." If a name is in general use, though it violates the code it may be validated (in one or another way) by the Commission in suspension of rules. Unfortunately this method breaks down, because the preparation of a case and the validation is a long and tedious matter, and in the meantime code-enthusiasts take up the technically valid but dormant name, so that long before a decision is reached, the unanimity on which a decision should be based has vanished. And where there is any real uncertainty, with a resulting real confusion of use, the process has generally broken down completely.

There is a complication which seems at first minor, but works out near the bottom of most of our practical difficulties. This is where the two names have been given to what is practically the same list of species. In that case shall we treat the two names strictly as synonyms, or if the group is later divided, shall we use each of these names for one of the later groups? The latter has been rather the tendency, but the practical result of our present code is highly inconsistent, and the earlier practice (so-called elimination method, actually giving the right to the first reviser) produced a high per cent of ambiguous cases, mainly because the two authors who had originally proposed the rival names hardly ever had just the same assortment of species before them. In practice we cannot be quite sure whether they meant the same thing or not.

Take Danaus, Pieris, Pontia, etc.,—these half a dozen names were all intended primarily for the cabbage butterflies. Yet each author had doubtless a different conception. Linnæus, who included the monarch, certainly did not have quite the same conception as the later workers.

Thirdly we have the names of groups. This is also a very old category, as Aristotle if not even earlier philosophers, had their groups of animals and plants, Entoma and the rest. Where our recent history of genera and species has been a war of policies and codes, the group names till very recently have been nearly free from all this. Practically our present code only requires two things, (1) if the group name is based on a genus, it must be a genus-name recognized as valid by the writer; (2) it must not be a homonym. Outside of this we have merely the policy of "judgment" formerly in use for all names, and still in use for morphological nomenclature and the like.

Just before the war began a movement to bring these group names also under a strict law of priority. It was sponsored in the fields best known to me by people who had a unique code somewhat different from the official one, and resulted in some weird changes as they applied it. This first attempt was to require that the name of each family must be based on the *oldest* genus-name in it, regardless of whether that name had ever been used as the basis of a group-name before.

Another worker has (for family names) considered those names which end in the present conventional ending for family names (-idæ), and applied the law of priority strictly on that basis. Others give priority to the oldest group-names involved, regardless of its exact form, and modify it to the conventional present-day form for the category concerned.

Most recently there has appeared a group who wish to extend the "type" principle to these group names, and have a certain species (or genus) chosen as type of each higher group, which shall always be in the group. In this case if the type genus changes its name the family will also change to the corresponding name.

An example: Our *Ctenucha virginica* belongs to a certain family, long known as the *Syntomidæ*. The genus Syntomis is a synonym of Amata, so (unless the present hopelessly slow conservanda mechanism comes into play), we must abandon Syntomidæ even under the present brief provisions of the code. The type of the Syntomidæ may be considered *Syntomis phegea*, the type of Syntomis as generally used, now become *Amata phegea*. Shall then the name of the new family be *Amatidæ,* as used by Hampson? or shall we resurrect the old name of Packard, Grote and others and call it *Euchromiidæ,* Euchromia being a perfectly valid genus, but in another subfamily?

What then, is the *tendency* in nomenclature? I see two, definitely at war with each other. One is in nearly complete control of one field (the specialists in nomenclature), the other has nearly as strong a hold in another (the general workers). *First* we have an attempt to rectify law by more law,—to improve, supplement and clarify our present code by further legislation. I know the weight of colleagues of mine behind this point of view, which is exceedingly plausible, for it would seem as if by either rule or judicial decision a million names might be managed as well as a million people. But new people are born, and new problems arise, and personally I see no end. There is the further difficulty that we have only one court for first and final resort alike. Its docket is hopelessly crowded now, and yet it only passes on a minute proportion of the cases in urgent need of decision. If we wait for this method the millenium will see us waiting; if we apply the rules informally and unofficially on each doubtful case that comes our way, experience has already shown that we will come to about as many conclusions as there are entomologists.

Finally we may return to the practice that arose in the days of the Napoleonic wars, when the old custom of Swedish authority broke down. Let each man choose the name that he thinks least likely to be misunderstood by his readers, regardless of rules, precedents and priorities. This will obviously lead to inconsistencies, to current synonyms side by side, and, perhaps most serious, to divergent national uses. But experience seems to indicate that there will be a gradual drift toward uniformity, for after all, the name most in use is the one most likely to be correctly understood, and a name already in dominant use will with steadily increasing momentum, tend to occupy the field.

It seems to me that in the field of major groups, where there has never been a formal code, and confusion is not really great at present, this is the only true good policy.

When we come to genera and species, where we have complex existing codes, the matter is less simple. I believe it is best to follow the code wherever we can do it without confusion; but to anticipate the likelihood of a conservanda decision in many cases where a strict interpretation of the code would seem to overturn a well-known name, and continue to use the current name in the interim, till the preparation and decision of a case before the Commission is possible. But *when a definite decision leads to a definite name,* to accept the decision as promptly as possible. A decision which leaves a residual ambiguity, as in a recent notable case, I should not interpret as a final decision.

We end, then, much as we began under Linnæus; with *Authority*, qualified by *Judgment*, especially where authority does not lead to an unambiguous result; following *Priority* as far as practicable, but not making it the final arbiter.

ON CERTAIN FORMS OF COMMON AMERICAN BUTTERFLIES.

By Austin H. Clark

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In any large series of butterflies of any single species the individuals are seen to be divisible into various forms. These forms are of two types, those due to a response to environmental conditions, that is, to a response to the chemistry and physics of their environment, and those due to physiological indiosyncracies on the part of certain individuals, that is, to their internal chemical and physical condition.

Examples of the first are cold and hot and wet and dry forms and local varieties. Examples of the second are alternative forms in either sex or in both sexes, and most of the variants usually classed as "aberrations."

There is no sharp distinction between these two classes, for a species may have, for instance, a long range of alternative forms in one region and none in another, or variants of one or several types may be frequent in one area and rare or unknown elsewhere, or may occur only in certain years, which clearly has to do with environment.

In the following pages attention is called to a few forms from among our common native butterflies which, by analogy with corresponding forms elsewhere, seem susceptible of interpretation as wet and dry forms.

It is presumable that a wet form of a butterfly is a form adapted to developing in the presence of an amount of moisture equalling or in excess of the maximum requirements. This moisture may be furnished either in the form of abundant water in the food, or abundant water available for ingestion with the food. A dry form would be a form living in the younger stages on food with an amount of water at or near the minimum requirements. This might be due (1) to seasonal variation in the precipitation, (2) to differences in soil conditions, as between bogs and well drained dry uplands, or to seasonal variation in the condition of the food plant, as for instance the moist condition up to the time of flowering and the dry condition after flowering or toward the end of the growing season.

Wet and dry forms are more or less independent of temperature. For instance, all the forms of *Eurymus eurytheme* about Washington in the summer are clear yellow on the under surface of the wings and in the autumn are heavily infuscated. But wet forms seem to be very sensitive to dessication in the extreme cold of winter if they hibernate as adults or as pupæ.

Here as elsewhere there is to be remarked a considerable difference in habits between wet and dry forms, the latter being always the more active.

Junonia cœna.—The common buckeye occurs in the District of Columbia in two quite different forms.

In the usual form the fore wings measure about 27 mm. in length in the females and about 24 mm. in the males. The ground color above is a medium brown. Beneath the ground color of the hind wings and of the apex of the fore wings is light gray, usually slightly tinged with buff, and there are two conspicuous oval black spots about as broad as, or narrower than, an interspace which are narrowly ringed with buff not far from the outer margin of the hind wings.

The wings are dry and brittle, and nearly all the individuals caught are nicked or more extensively damaged.

This form is exceedingly alert and active and a very strong flier. If alarmed it flies rapidly away, often not pausing before it is out of sight. It is fond of flowers, especially white flowers rising well above the grass, and for resting it always chooses the summit of a tall weed or of a tall dead stem or the bare ground from which it can easily dart away in any direction.

It is found throughout the District, most abundantly in dry open country, and is not infrequently noticed in the parks and about the streets of Washington.

In the other form the fore wings are about 30 mm. long in the females and about 28 mm. long in the males. On the upper surface the ground color is dark and the brown of the fore wings and of the outer half of the hind wings sometimes shows dark green metallic reflections. On the under side the whole of the hind wings and the apical portion of the fore wings is dull pinkish red, often quite uniform, but usually darkest in a long irregular narrow triangle bordered by irregularly crenulate lines running from a base near the outer angle to an apex near the anal angle. This triangle often includes two small oval blue spots narrowly ringed with lighter, or some traces of such spots. The wings are somewhat fuller and less angulated than the wings of the preceding form.

The wings are curiously soft, and are rarely broken or torn, though they may be rubbed. The insect always feels as if it had recently emerged from the chrysalis.

It is sluggish and rarely flies for more than fifty feet or so, alighting usually on the ground in thin grass or weeds. It is not shy and is easily captured. I have never seen it on a flower.

It is exceedingly local and is confined to boggy lowlands with an abundant growth of *Agalinis purpurea* on which the larvæ feed. It is very numerous in the restricted areas where it occurs, appearing in late summer.

Not infrequently in late summer individuals of the small light form are taken in moist areas which show an approach to the large dark form in a greater or lesser development of pink markings on the under side of the hind wings. But as a rule the two forms are quite distinct, at least in this region.

As the large dark indolent form is strictly confined to wet meadows while the small light form is the only one occurring in dry situations, it is logical to consider the former as a "wet" and the latter as a "dry" form. Moreover, the differences between these two forms are essentially the same as those between the wet season and the dry season forms of the Asiatic *Junonia orithya, J. almana* and *J. iphita.*

In Asia the wet and dry forms of *Junonia* alternate. With us the wet form develops from eggs laid by the dry form, as in India. But it only develops in water-logged localities, the young of the dry form elsewhere being a new dry generation.

So far as known the wet form in the District of Columbia dies out completely during the winter.

The wet form of our *Junonia cœna* in this region, therefore, is represented by local colonies leaving no descendents which originate from dry parents.

Cynthia atalanta.—Like the buckeye, the red admiral occurs in the District in two quite different forms. In boggy areas with an abundant growth of the false nettle (*Bohmeria cylindrica*) there appear in late summer large individuals which above are blackish instead of brown with the border of the hind wings redder than in the usual form and the band on the fore wings redder and narrower and crossed by black veins, and below are much darker, especially on the hind wings.

This form differs from the usual type just as the "wet" form of *Junonia cœna* differs from the "dry" form, occurs in the same localities, and appears in the same way in late summer.

It seems not to survive the winter, as all the numerous spring individuals caught in the places where the dark form is later to be found are of the small brownish form. It is to be interpreted as a "wet" form descended from "dry" parents and leaving no progeny.

Cynthia cardui.—Within the District, and throughout the whole of New England except for the southern coast, the painted lady when it occurs is represented by a large form with the fore wings slightly shorter than usual and sometimes very short, and the hind wings slightly broader and more rounded. The color is dark and brilliant, and the upper surface and the inner portion of the lower surface of the fore wings is strongly tinged with pink. The submarginal spots on the hind wings are usually large, and not infrequently on the upper surface show conspicuous blue centers.

This form, which is the only one found in the District and in most parts of New England in the summer and autumn, seems to be the "wet" form of this species which, like the corresponding forms of *Junonia cœna* and of *Cynthia atalanta*, cannot survive the winter.

So far as I have been able to learn, wherever this form occurs exclusively this butterfly is of uncertain and more or less irregular appearance. It survives the winter only where the smaller, duller, longer winged form is to be found in the late summer.

The more or less irregular occurrence of this insect in great numbers over wide areas not permanently inhabited by it and its complete disappearance during the succeeding winter are readily explained if we recognize the existence of a "wet" form comparable to that of *Junonia cœna* and *Cynthia atalanta.*

The "dry" females in the spring are very active and wander in every direction, scattering their eggs over a wide extent of territory. If they are numerous and if conditions are favorable they will become dispersed over regions far beyond the area where they passed the winter.

This species differs from the two just considered in being normally an inhabitant of semi-arid regions. Under the conditions found in the District and in the greater part of New England the young from over-wintered females develop into the large and brilliant "wet" form, which appears in July. The young of these summer butterflies, appearing on the wing in late August and September, are of the same form as their parents. But in the District spring individuals, which are not at all common and are only to be seen in the low ground near the river, are always of the "dry" form.

So apparently the reason for the irregular appearance of this butterfly is that in most of the area from which it is known its caterpillars develop into a form unable to survive the winter and its occurrence therefore is dependent on regular, more or less irregular, or occasional incursions of overwintered females from elsewhere.

Polygonia interrogationis and *P. comma.*—The foregoing interpretation of the forms of *Junonia cœna, Cynthia atalanta* and *C. cardui*, and analogy with *Polygonia c-album cognata* and *P. c-a. agnicula* of the Himalayan region and *P. c-a. hamigera* of Japan, Corea and northern China, suggest a corresponding interpretation of the seasonal forms of *Polygonia interrogationis* and *P. comma.*

In the District of Columbia the light form of *P. interrogationis* is variable in color, some of the individuals being much darker than others, especially in the female. In *P. comma* the light form seems usually to be darker than in New England with more extensive infuscation of the hind wings, some individuals, indeed, being almost as dark as the dark form. In both species the shape of the wings is constantly different in the two forms, so that such indications of intergradation as occur are wholly in the color.

The autumn brood of these butterflies is invariably of the light form. The summer brood is of the dark form, with which there are usually to be found a few individuals of the light form.

These forms probably reflect wet spring and dry summer conditions acting on the food plants.

In both species there is a wide difference in the habits of the two forms, the dark form tending to remain within a restricted area in or near woods and the light form scattering widely over open country. This recalls the difference in habits of the two forms of *Junonia cœna.*

Eurymus eurytheme.—From the description of the succession of forms of the orange clover butterfly in Texas and elsewhere in the southwest it would seem that *ariadne* is a dry form of this species, *keewaydin* an intermediate form, and the deep orange *eurytheme* with a more or less brilliant violet iridescence in the males the extreme wet form.

In the District the earliest individuals to appear are of the extreme wet form, *eurytheme.* In July the *keewaydin* form appears, flying with the other until the end of the season and intergrading with it. Early in August the *ariadne* form appears, but it is scarce until after the middle of September when it becomes frequent, though not very common. It flies with the other two until the end of the season in October or November.

About Washington there is noticeable a difference in the distribution of these three forms. The deeply colored *eurytheme* is most numerous in the lower areas, especially along the river. The most intensely colored and the largest individuals are to be found in the wet meadows beyond Cabin John. In the higher country the individuals appear never to reach such a large size as they do here, while the relative proportion of the forms *keewaydin* and *ariadne* appears to be greater.

The forms *ariadne, keewaydin* and *eurytheme,* which appear in seasonal sequence in the southwest, about Washington seem to appear in response to very local conditions, permanent wetness in the boggy pastures and progressive drying in the higher areas, which accompany the general trend from wet spring to dry autumn.

COLORATION IN *POLISTES PALLIPES.*

By Phil Rau,

Kirkwood, Mo.

A careful examination of a half-dozen cedar trees revealed four small, partly disintegrated nests of *P. pallipes* and only one new nest which contained living adult wasps. This nest was well protected by the close foliage. The entire family was taken. All the cells of the nest were empty, showing, of course, that all of the occupants had emerged. Furthermore, there were no partly constructed cells, an indication that pulp gathering as well as egg laying stops long before the cold weather begins; at least in this nest the wasps had not gone on blindly making cells when the cold would have cut short the life of the young.

The nest was of the usual round type, and had 106 cells with 59 adult wasps upon it. All of the cells appeared to have been used but once. The population comprised 23 males, 28 workers and 8 females. The latter were larger in size and were therefore believed to be queens. That conviction was sufficintly strong to warrant the heading "Coloration in *Polistes*," for if these queens had not been present, I certainly should have identified all the others in the colony as *P. variatus;* the queens only were typical *P. pallipes.*

This entire colony of 59 wasps was taken just because it contained what I thought were two distinct species (according to the taxonomists). At first sight one would say this was a mixed colony, probably the result of its having been founded by two queens of the respective species, except for three reasons:

1. We already know the antagonism between these species.[1]

2. We often find the males of *P. pallipes* abundantly marked in yellow so that they resemble *variatus.*

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[1] Paper in course of publication.

3. If I had found only the males marked in yellow, I could have accounted for it on the ground of the usual condition of the greater tendency of the males to vary (see Enteman), but here I found that the workers, 28 in number, actually showed the coloration which is characteristic of the male; in fact, the similarity was so strong that only by counting the abdominal segments could the sexes be distinguished. The male *pallipes* showed the conspicuous yellow bands about the segments, some of which extended around to the dorsal surface; precisely the same condition obtained in many of the workers, only the degree of marking varied in the individuals of both sexes. I submitted to an expert some of these workers so colored, and he identified them promptly as *P. variatus*. Hence this is in all probability a colony of *P. pallipes*, with the males showing variation toward *variatus* and the workers too resembling the males. Dr. C. H. Turner[2] has shown that the workers of *Vespa carolina* resemble the males in coloration.

Whether this perplexing condition is the result of the founding of the colony by two mothers of distinct species, which is improbable, or whether it is a case of pure variation within the colony, it shows one very important aspect of the study of variation, viz., that it is of supreme importance to make studies from a sufficiently large number of entire colonies taken directly from the nest near the end of the season, especially in the preparation of such works as Enteman's "Coloration in Polistes." There she states (p. 21); "*P. variatus* merges into *P. pallipes* as we pass eastward, and into *P. aurifer* as we cross the plains to the southwestward," and again (p. 37) "It is hardly probable that we have in *P. variatus* a primitive species which has differentiated in two directions, but as we shall see from a study of a geographical distribution of the species, *P. aurifer* and *P. pallipes* are two originally distinct species which, from the course of their migrations northward, have come together in the Mississippi Valley and by their co-mingling produced a species having in some measure the characteristics of both."

Yet I believe that the 59 insects taken from this nest were all of one species, and possibly the reader will agree

[2] Psyche, February 1908, page 1-3.

with me, relying on the evidence presented by Miss Enteman (p. 43) where she speaks of the development of the pattern of *P. pallipes;* "In the dark variety of *P. pallipes* characteristic of New England, the early developmental stages, as studied in a great many specimens, are identical with those described for *P. variatus*. The only difference between the two species is that the typical *P. variatus* stops, so to speak, at an earlier stage than does *P. pallipes*, which advances to the same melanic condition of *P. variatus*, and in most cases passes far beyond it."

If in this nest all are variations of one species, then we see that in the workers and males pigmentation stopped too soon and created the condition of *P. variatus*, while in the eight queens something queenly in their make-up "caused" advances to the extreme melanic condition which is taxonomically known as *P. pallipes*.

NEW SPECIES OF DOLICHOPODIDÆ FROM THE WEST INDIES, (DIPTERA).

By M. C. Van Duzee,

Buffalo, N. Y.

Psilopus salti, new species.

Male: length about 5 mm., head broken off in the type. Thorax and abdomen dark green, their bristles short; more than half of the abdominal segments opaque black, apical part of segments and whole of last one green; venter and sides of first segment with long pale hairs. Hypopygium (Fig. 2) small, its lamellæ black, fringed with hair and with several flattened, clavate bristles on one edge.

Coxæ black, anterior pair with rather long yellow hairs at tip; femore green with long white hair below; fore and middle tibiæ yellow, anterior pair with two long bristles below, the one near the middle nearly one-third as long as the tibia, middle ones with two rather long bristles on lower anterior edge; posterior tibiæ black; first joint of fore tarsi mostly yellow, middle tarsi brown almost to their base, posterior pair wholly black; last four joints of fore tarsi with only short hair below; all tarsi plain, except that the fifth joint of middle tarsi is nearly as wide as long; length of fore tibiæ about as 70, joints of fore tarsi as 50-18-14-8-6; those of middle ones as 65-22-14-6-5; joints of posterior ones as 65-26-15-6-5. Calypters yellowish brown with the tip and cilia black; halteres yellow.

Wings sligthly tinged with brown in front of second vein; last section of fourth vein from the cross-vein to the fork 32, from fork to wing margin about 30, cross-vein 31 and last section of fifth vein about 27 fiftieths of a millimeter long; fork of fourth vein almost a right angle, the upper bend broadly rounded.

Described from one male, taken at Mina Carlota, Trinidad Mountains, Cuba, March 21, 1925, by George Salt, for whom the species is named.

Type in the Museum of Comparative Zoology, in Cambridge, Mass.

Psilopus albihirtus, new species.

Male: Length 5 mm. Face broad, green with a little white pollen; palpi black; proboscis brownish yellow; antennæ black, short, longest bristles on second joint above and as long as the antenna; front blue-green with a few pale hairs on the sides; lower orbital cilia white, not long or abundant.

Thorax and abdomen green; segments of the abdomen broadly opaque black at base; the white hairs on the venter not very long; bristles of thorax and abdomen short. Hypopygium (Fig. 1) black, rather small; its lamellæ forked, one branch fringed with slender hairs, the other branch, which is cut off straight at tip have a fringe of shorter and stiffer hairs at tip.

Coxæ black; anterior pair fringed with long, whitish hair on outer surface; femora green with long white hair below; tips of fore and middle femora and their tibiæ yellow, the latter with rather short bristles; hind tibiæ black; fore tarsi (Fig. 3) with the first joint yellow, remaining joints black, second, third and fourth joints with blunt spines below, fifth joint short and nearly as wide at tip as long; middle tarsi brown, posterior pair black, both plain; fore tibiæ as 72, joints of fore tarsi as 60-17-10-6-4; of middle pair as 67-18-15-6-5; joints of posterior tarsi as 53-18-13-8-5. Calypters brown with black cilia; (halteres broken off in the type).

Wings grayish, very slightly tinged with brown in front of third vein; venation about as in *salti* new species.

Described from one male, taken near Troy, Jamaica, May 23, by A. E. Wight. Type in the Cambridge Museum.

The tarsi are formed very much like those of *patibulatus* Say and *pilicornis* Aldrich, but differs from both in having the wings without cross-bands and the fore and middle tibiæ pale yellow, it also differs in other characters. It is very nearly like *salti* new species, but differs in the form of the fore tarsi.

Pelastoneurus furcatus, new species.

Male: length 4 mm. Face and front in the type greasy so I could not tell their color; antennæ yellow, third joint small, rounded, scarcely as long as wide, apical edge black;

arista inserted at upper basal corner, it is broken off in the type but still adheres to the head and has several long hairs along the middle, it might be much more fully feathered if in perfect condition; lower orbital cilia white.

Dorsum of thorax blue on apical half, more coppery along the front and median line; scutellum reddish coppery with a depressed area on each side of a median ridge, it has one pair of large marginal bristles and a pair of small hairs outside of them. Abdomen green with black hair and with the hind margins of the segments coppery. Hypopygium (Fig. 4) with the upper part black, the lower portion yellow, it has a short perpendicular segment which is scarcely as long as high, the hypopygium reaches nearly to the second ventral segment, its lamellæ yellow on basal half, blackish on apical portion, somewhat triangular, or rounded, they have many slender hairs on apical margin and also several short, bent, flattened, blunt ones; on the lower corner of the hypopygium are two long, branch, pale hairs, these are nearly as long as the lamellæ.

All coxæ, femora and tibiæ yellow, outer surface of basal half of middle coxæ and all tarsi from the tip of the first joint brown; fore coxæ with a few black hairs and bristles; joints of fore tarsi as 40-25-19-11-10; two first joints of hind tarsi as 29-40. Calypters and halters yellow, the cilia of the former appears yellowish.

Wings grayish; first vein reaching but little more than half as far as the cross-vein; third vein nearly straight, last section of fourth vein bent near apical third; slightly concave posteriorly beyond the bend, its end near the tip of third vein; cross-vein 15, last section of fifth vein 23 fiftieths of a millimeter long.

Described from one male, taken by George Salt, February 25, 1925, at Soledod, Cuba. Type in the Museum of Comparative Zoology, in Cambridge, Mass.

This like *neglecta* Wheeler, *fasciatus* Roeder and *wheelri* Melander has the hypoygium about half yellow, but it is separated from these by the form of the hypoygial appendages. *Neglectus* like this species has a few branched bristles on the hypopygium, but they are much shorter than in this form.

THELYTOKY IN *SCLERODERMA IMMIGRANS.*

BY CLYDE E. KEELER

The Problem.

For some time I have been interested in the presence and absence of wings in the Bethylid, Scleroderma, and the possible mode of hereditary transmission for these conditions. We know that in this form apterous females and alate males are the rule, while winged females and wingless males occur rarely. In these facts we have evidence that the question is related in some fashion to sex determination.

Among the Apidæ and Bombidæ, sex determination appears to be capable of a quite simple explanation. A single complement of chromosomes bearing a certain ratio of male and female producing factors sets up a metabolic developmental rate characteristic of males.

When a double complement is present, as in the fertilized ovum, a new ratio of metabolic tendencies is established and the result is a female.[1]

Nachtsheim postulates for the honeybee *Apis mellifica* a sex determination similar to the following:

Results.

$$\begin{aligned} &\female = 2X + 2A = -4 + 2 = -2 \\ &\male = X + A = -2 + 1 = -1, \\ \text{where } &A = \text{autosome set} = +1, \text{ and} \\ \text{where } &X = \text{sex chromosone} = -2. \end{aligned}$$

The same method of analysis may be applied to other Hymenoptera such as the parasitic form *Microbracon (Habrobracon) juglandis*, where numerous investigators have found that virgin ♀ ♀ produce males only.

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[1] Upon the same theory, by assigning hypothetical weights to sex chromosomes and autosomes, Bridges has been able to account for sex determination in normal Drosophila melanogaster as well as the several types of experimentally produced forms bearing aberrant chromosome numbers. Likewise, Goldschmidt account for intersexual forms of *Limantria dispar* produced by interracial crosses.

Sex determination in the Bethylid, *Scleroderma immigrans*, was formerly thought similar to that of the Apidæ where unfertilized females produce males.

The Material.

My stock of *Scleroderma immigrans* was obtained in Hawaii through the kindness of Dr. Swezey, to whom I am very much indebted.

Having been acquainted with the fact that in Prof. Wheeler's study of the Texan *Scleroderma macrogaster*, he was able to use quite a variety of food material, I expected to employ the larvae of the mediterranean meal moth Hephestia of which I had a large stock prepared for Microbracon culture.

My Sclerodermas refused bark borers and longicorn beetle larva and did well only upon larvæ and pupæ of the pine weevil *Pissodes strobi.* My stock finally perished when the latter food became unavailable.

In the spring of 1928 several vials containing cocoons were received from Dr. Swezey. The parents (which we shall call P_1 generation) were probably born shortly before April 10th, when some of the eggs were laid. They consisted of apterous females and alate males.

The results of my breeding experiments are shown in Table I.

TABLE I.

P_1	F_1	F_2	F_3	F_4
winged ♂♂	3 winged ♂♂	2 winged ♂♂	1 winged ♂	1 naked wingless ♀ pupa (from wingless ♀ x wingless ♂)
			1 wingless ♀	14 wingless ♀♀ (from 3 virgin wingless ♀♀ b. Oct. 31)
wingless ♀♀	44 wingless ♀♀	25 wingless ♀♀	12 wingless ♀♀	19 wingless ♀♀ from 1 virgin wingless ♀ b. Nov. 1)
				1 wingless ♀ (from 3 virgin wingless ♀♀ b. Nov. 12; dead in cocoon)
				3 wingless ♀♀ (from 3 wingless ♀♀ x winged ♂)
				9 wingless ♀♀ pupæ (from 1 virgin wingless ♀) (cocoons opened Dec. 8)
Hatched before April 10	Hatched May 13	Hatched June 28	Hatched Aug. 4 to Sept. 16	

The first filial generation (F_1) consisted of 3 winged males and 44 wingless females.

The second filial generation (F_2) was composed of 2 winged males and 25 wingless females.

The third generation (F_3) contained 1 winged male, 1 wingless male, and 12 wingless females.

Eight of the 12 wingless females of the F_3 generation were kept virgin, while three females were mated to the winged male. A single female was mated to the wingless male.

In the F_1 from wingless female x wingless male one naked wingless female pupa was produced. It died before maturity.

Three virgin wingless females produced 14 wingless females.

In another vial one virgin wingless female produced 19 wingless females.

Again 3 virgin wingless females produced one wingless female. It died in the cocoon.

The three wingless females mated to the winged male produced 3 wingless females which died in their cocoons.

A wingless virgin female produced 9 wingless female pupæ. These I removed from the cocoons alive.

In all, wingless females x winged males produced 6 winged males, 1 wingless male and 84 wingless females. Wingless females x wingless males gave one wingless female. Virgin wingless females produced 33 wingless females.

Conclusion.

From the fact that virgin females in general produced females, we see that we are dealing with a mode of sex determination differing from the Apis type which must be worked out before the question of the inheritance of wings may be comprehensively attacked. Could I have been dealing with a parthenogenetic strain or has change of conditions produced a functional difference in reproductive mode? It is hoped that someone, working where suitable food supply is available the year round, may take up with Scleroderma this interesting problem of sex determination and its allied question of wing inheritance.

NEW ASILIDÆ FROM MEXICO (DIPTERA).

By S. W. Bromley

In a shipment of Asilidæ from Mexico received from Dr. Alfonse Dampf, the following new species were found.

Plesiomma atrum n. sp.

Length 21-23 mm. A deep black species with black wings.

Male. Head black. Face brown pollinose. Mystax, beard, occipital bristles, antennal bristles and palpal hairs, black. Thorax deep brown with a slender double median line of black and black side spots. Vestiture black. Legs deep brown, femora and hind tibiæ black. Knees lighter brown. Scutellum with 2 black marginal bristles. Wings black without irridescent reflections. Abdomen black. Genitalia black with black hairs.

Female. Similar.

Holotype, ♂, no. 70 Coatepec (Ver.); allotype, ♀, no. 69 Coatepec (Ver.) paratype, ♂, no. 28. Jaltipan, Istmo (Ver.)

Deromyia bellardii n. sp.

Length, 20-26 mm. A rather large reddish species with contrasting deep black lines on the thorax, the abdomen slightly coarctate in the male but not so in the female, and the abdomen in both sexes being uniformly deep reddish without black markings on the sides of the segments.

Male. Mystax sparse, whitish. Face pale yellow pollinose. Antennæ light reddish with black hairs. Palpi deep reddish brown with black hairs. Occipital bristles black. Thorax yellowish pollinoses with three deep black velvety lines on the mesonotum, the median line extending to the anterior margin. Bristles of mesonotum black. A few black bristles in front of halteres. Coxal hairs pale yellowish. Legs reddish with black bristles. The upper surfaces of the femora and tibiæ are darker. The distal portion of the posterior tibia is brown. Scutellum reddish gold with 2 black marginal bristles. Wings nearly hyaline, apex and posterior border grayish. Halteres reddish brown. Postscutellum with a median dark marking. Abdomen reddish, the sides lighter. Genitalia reddish with yellow hairs.

Female. Similar, but legs more uniform reddish in color. Abdomen not coarctate. Pronotum with black bristles.

Holotype, ♂, no. 55 Distrito Federal (?).

Allotype, ♀, no. 156 Colima, Col.

Deromyia bimaculata n. sp.

Length 22 mm. A slender reddish species, with three velvety black lines on mesonotum, the abdomen coarctate, reddish, with two black spots on the 5th tergite, one on each side.

Male. Antennæ reddish with black hairs. Face pale yellow pollinose. Mystax scanty, white. Palpi reddish with black hairs. Occipital bristles black. Beard sparse, pale yellow. Pronotum with black bristles. Thorax golden pollinose. Mesonotum with three deep black lines, the median line reaching the anterior border. Bristles black. Scutellum reddish with 2 black marginal bristles. Coxal hairs pale yellow. Legs reddish with black bristles. A black line on the anterior portion of the side of the hind femur. Wings long and wide, pale yellowish, apex and posterior margin grayish. Abdomen reddish, coarctate, the 4th segment the widest; the fifth with a black spot on each side. Genitalia reddish with yellow hair.

Holotype, ♂, Cuernavaca. Aug. 11?.

Andrenosoma igneum n. sp.

Length, 21 mm. A black species with all black legs, the 6th and following segments of the abdomen reddish, rest of abdomen black with a deep reddish hue in the median area of the first 3 segments.

Male. Proboscis, antennæ (3rd segment missing), palpi and palpal hairs, antennal hairs, the two ocellar bristles, black. Beard, hairs on sides of face and occipital hairs, whitish. Mystax composed of many, thickly-placed, short, stout bristles, mostly black, but a few pale yellowish ones in the upper part. Thorax black, grayish pruinose, the mesonotum with two black median lines and two lateral spots on each side. Pleura gray pollinose and white haired. Mesonotal bristles black with a few white hairs anteriorly. Anterior portion of scutellum grayish pollinose, with black hairs and marginal bristles. Halteres pale reddish. Wings nearly hyaline, the apex and posterior border lightly grayish. Legs black, the femora and tibiæ covered thickly with long fine white pile. A few black hairs and bristles present; those of tarsi all black. First five segments of abdomen black with a black bristle and fine white hairs on each side of the segments. The first three segments have the median area of a deep reddish hue, and the 6th and following segments are light reddish with reddish hairs. Genitalia small, reddish with concolorous hairs.

Holotype, ♂, no. 63. Coatepec (Ver.)

Mallophora albicincta n. sp.

Length, 22 mm. A rather slender species, related to *M. nigritarsis* Wied. and *M. scopifer* Fabr. having a white beard, yellow face and mystax, brown thorax, yellow legs (except tarsi which are black) and a black abdomen with snow-white hairs on the first 2 segments. There is a tuft of white hairs on the scutellum also.

Female. Antennæ black with black hairs. Palpi black with yellow hairs except on tip where hairs are black. Beard white. Mystax and face golden, a number of black bristles in lower portion of mystax. Occipital bristles black, hairs pale yellow. Thorax dark brown. Pleura and pronotum with white hairs. A few black bristles over base of wings. Scutellum yellowish brown, thickly set with white hairs. Coxæ piceous; femora and tibiæ (except tip of posterior tibiæ which is blackish) bright yellow with concolorous hairs. A few black bristles at base of hind femur. Tarsi piceous with black hairs and bristles. Abdomen black, ventral hairs white. First two tergites with white hairs, rest with short black hairs. Ovipositor with fine white hairs.

Holotype, ♀, no. 57. Coatepec (Ver.)

FURTHER NOTES ON THE HABITS OF *HARPAGOXENUS AMERICANUS*.[1]

By Wm. S. Creighton

The social parasitism of *Harpagoxenus americanus*, Em., has been discussed by Sturtevant in a paper published in 1927. This investigator found that the behavior of an artificially deälated *Harpagoxenus* female placed in a nest of *Leptothorax curvispinosus*, one of its natural hosts, agrees in all essential respects with that of the females of the *sanguinea* group in *Formica*. The strange queen is at once attacked by the *Leptothorax* workers but she eventually cripples most of her assailants, disorganizes the remainder and takes possession of the brood.

During the summer of 1928 I was stationed on Naushon Island (Woods Hole), Mass., the only place in New England where *Harpagoxenus* is known to be at all plentiful. I was fortunate in securing several mixed colonies and in rearing from one of these numerous males and females. There was consequently abundant opportunity to repeat the experiment previously made by Sturtevant. Our results differ only in minor details which may be due to the fact that he used *L. curvispinosus* as the host while I employed *L. longispinosus*. Sturtevant introduced his deälated *Harpagoxenus* female into a nest containing seventy workers of *L. curvispinosus* and secured good results. I found it necessary to strip the host nest of all but about fifteen workers in order to prevent the death of the *Harpagoxenus* queen. If a larger number of *longispinosus* workers were present they invariably pulled down and killed the intruder by force of numbers. The worker of *longispinosus* is slightly larger than that of *curvispinosus* and its greater size may give it an advantage in attacking the invader. It was also necessary to wait for one hour after deälating the *Harpagoxenus* female before placing it in the nest of the host. If placed therein immediately after deälation it behaved in a most apathetic manner and was quickly dispatched by the *Leptothorax* workers before it showed any signs of pugnacity. Since the wings are very easily removed it does not seem probable that this initial quiescence can be due to the shock of the operation. A more likely explanation appears to be that the high degree of excitability so characteristic of the actions of many of the queens of the social parasites is in some way connected with the degeneration of the wing muscles. Such a process would require an appreciable lapse of time before it could become effective.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 311.

The results of nine experiments in which an artificially deälated *Harpagoxenus* female was introduced into a nest of *Leptothorax longispinosus*is may be summed up as follows:

The strange queen almost immediately approaches the brood and is at once attacked by the *Leptothorax* workers. She defends herself with extreme ferocity, biting off the antennae and legs of her assailants with quick, jerky movements and giving them little opportunity to seize her. Whenever possible the *Harpagoxenus* queen returns to the brood and drives away the *Leptothorax* workers who are moving the larvæ and pupæ. Her bursts of savageness are sometimes interspersed with periods of apathy during which she remains completely inactive and allows the *Leptothorax* workers to drag her about the nest. Eventually she maims or kills all the *Leptothorax* workers and takes possession of the brood. The *Leptothorax* queen is seldom attacked, since she avoids the intruder, but usually dies at the end of a few days, apparently from starvation. It is interesting to note that the *Leptothorax* callows very rarely show animosity or fear for the *Harpagoxenus* queen and are never molested by it.

In addition to the experiments with deälated females a few observations were made on *Harpagoxenus* brood. One mixed nest which was taken on June 15 contained a large number of larvæ, most of which subsequently proved to be *Harpagoxenus*. The length of the larval period could not be determined but the pupal period of the males and females is from twenty-three to twenty-five days. That of the worker is a day or two longer. There is no callow period for either worker or sexual forms. All are deeply colored at the time of emergence.

On Aug. 4, at 3:30 p.m. I witnessed a raid of *Harpagoxenus* and subsequently saw several others from the same nest. The raids differed in only one respect from those which I described in a previous paper ('27). The tendency of the raiders to move in columns, which I saw only once during former observations, was a regular feature of these raids. There were never more than six ants in a column. They moved in single file and kept quite close together. Their antennæ were rapidly vibrated and constantly brought in contact with the substratum or the ant ahead.

It may be of interest to note that *Harpagoxenus americanus* is now known to occur as far north as Boston, Mass. In the spring of 1927 I took a single female in the Blue Hills Reservation. The nest was small and contained, beside the queen eleven workers of *L. longispinosus* and a small amount of brood. No *Harpagoxenus* workers were present. The known range extends from Massachusetts through southern New York, New Jersey and eastern Pennsylvania as far south as Washington. It is likely that in the future our knowledge of its southern range will be considerably extended but the scarcity of the insect in Massachusetts points to this state as the northern limit of its distribution.

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NOTES ON *APHROPHORA SALICIS* DE GEER IN AMERICA.[1]

BY Z. P. METCALF AND G. W. BARBER

This common European Cercopid (*Aphrophora salicis* De Geer) was first discovered in the United States by Dr. Harold Morrison, who collected specimens in the Arnold Arboretum on various species of willow (*Salix petiolaris, S. nigra,* etc.) in July, 1921 and submitted them to Dr. Herbert Osborn, who identified them as above.

According to Lallemand[2] this species is widespread in Europe. According to Oshanin[3] it ranges from Hispania to "Sidemi bei Vladivostok" and from Suecia to Turkestan. This species was originally described by De Geer[4] as a variety of *Cicada spumaria.* It has been discussed by nearly all the European writers on the Homoptera from that time on. So far as we can discover, however, none of these writers give any notes on the life history. Therefore, since this species seems not to have been recorded before from North America and since it may prove to be of economic importance, we think it advisable to record our notes on distribution and our fragmentary notes on life history. The notes on life history were made chiefly during the summers of 1923 and 1924 and since these observations did not begin until after the middle of June and closed in late September, they are necessarily incomplete.

So far as our observations go the eggs are laid in the terminal twigs of willow, usually quite near the tips. (Fig. 8). The eggs are forced into the wood and frequently there are a number of egg punctures close together. These egg punctures contained two eggs although many contained but a single egg. These egg punctures are frequently so closely crowded that it is impossible to determine to which puncture an egg belongs. The anterior end of the egg usually lies near the surface of the twig with the ventral side of the developing embryo toward the outside of the twig.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 310.

[2] Lallemand, V. Homoptera Fam. Cercopicæ, Genera Insectorum, Fac. 143. p. 62, 1912.

[3] Oshanin, B. Verzeichnis der palæarktischen Hemipteren. p. 28, 1908.

[4] De Geer, C. Mémoires pour servir a l'histoire des insectes, 3. p. 180, 1773.

The eggs (Fig. 4) are elongate, sharply pointed at the anterior end, bluntly pointed at the posterior end and greatly flattened. The egg is embedded in a whitish substance which usually adheres to the egg at the anterior end and to the wood at the posterior end. The color is pearly white when first laid with the anterior ventral border brown. As the embryo develops the egg turns darker and the anterior ventral border becomes dark brown, with the pinkish eye spots showing distinctly. The surface is smooth. The length varies from 1.6—1.9 mm., greatest width 0.35—0.40 mm., greatest depth from 0.60—0.65 mm.

The nymphs apparently hatch early in May. By early June they are all in the third instar and by mid June in the fourth instar.

The nymphs of the third instar (Fig. 5) measure about 6—6.5 mm. in length. The head, thorax, legs, wing pads and anal segments are brown; the rest of the abdomen creamy white; eyes reddish brown; head large; frons inflated; antennæ with nine segments.

Nymphs of the fourth instar (Fig. 6) measure from 7.5—8 mm. in length. Nearly uniform pale yellow in color. Eyes reddish brown; wing pads well developed.

The nymphs have the habit of clustering together and forming large masses of spittle. (Figs. 2 and 3). These masses are more abundant on the terminal twigs and the water sprouts at the base of the tree than anywhere else. The spittle is secreted in large quantities and frequently runs down the branches to the trunk and then to the ground. Where the nymphs become abundant the liquid frequently drops from the trees in large drops, causing inconvenience to the people sitting under the infested trees. When the nymphs are full grown and ready to moult to adults they have the habit of crawling out on the under surfaces of the leaves where they form smaller spherical masses of

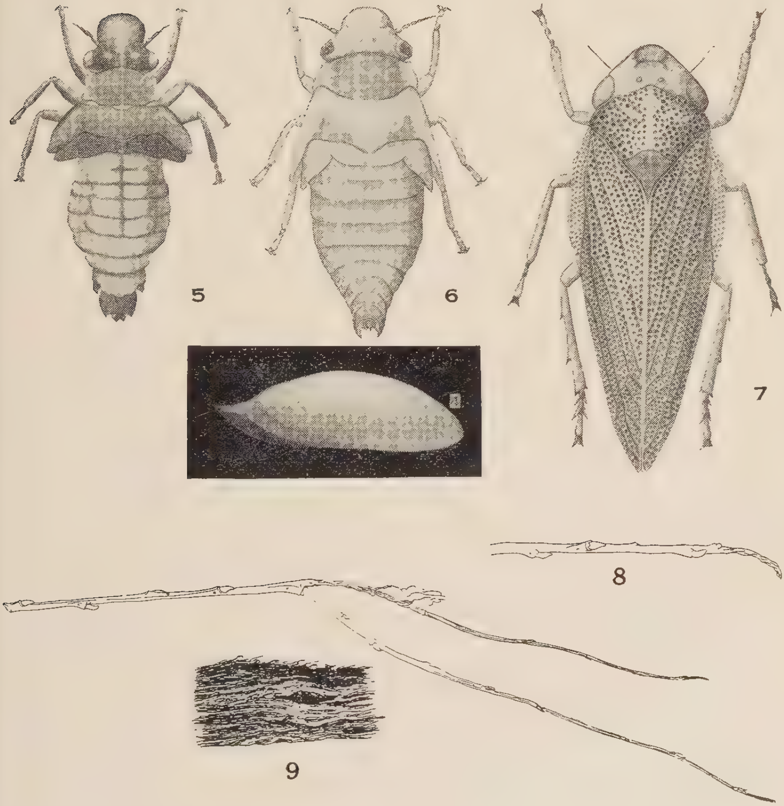


Fig. 1. 4, Egg of willow spittle bug, X 25; 5, Third instar nymph, X 8; 6, Fourth instar nymph, X 8; 7, Adult, X 8; 8, Terminal portion of willow twig killed by egg punctures; 9, Egg-laying puncture enlarged.

spittle, a single individual to a mass. (Fig. 1.) The froth dries somewhat, forming an arched vault in which the nymph transforms to an adult. The young adult remains in the vault until the skin becomes hard

The first adults (Fig. 7) were observed in late June and were common during July and August. Only a very few adults were still alive in late September when our observation ceased. After emerging the adults commence to feed and egg laying, according to our notes, begins in mid July.

This species may be distinguished from our native eastern Aphrophoras by its uniform yellowish color, with the prothorax, scutellum and elytra closely and uniformly punctate with small black punctures, each set with a fine golden yellow hair. Length, including wings, 10.5 to 11.0 mm.

Vertex twice as broad as median length; the anterior margins forming a right angle; median length one-half greater than length at eye; median carina well elevated; tylus more than twice as broad as long, uniformly punctate. Frons flat. Pronotum not elevated posteriorly; punctate spots fine anteriorly, coarser posteriorly; median carina distinct.

Genitalia: female, last ventral segment nearly twice as long as penultimate, convex, with the posterior margin roundly concave; ovipositor barely exceeding the pygofers. Male, eighth ventral segment twice as broad as long, anterior and posterior borders parallel; genital plates longer than broad at base; the ninth segment with lateral recurved hooks.

General color yellowish brown without conspicuous markings; numerous black punctures dorsally; the edge of the tylus bordered with black; eyes dark brown; tip of rostrum, claws and tibial and tarsal spines black; abdomen blackish, the segments bordered with brown and the genitalia brown.

Known in the United States from Arnold Arboretum, Boston, and from Mystic Lakes, Medford, Massachusetts.

So far as observed there was no injury from the feeding of the nymphs or adults. The only injury was caused by the egg laying of the adults. These punctures are sometimes placed several inches from the tips of branches and the entire terminal portion of the twig dies. This is apt to be of considerable importance on young trees that are used for ornamental purposes.

A survey of the willows in the Arboretum showed that this species infests 53 named species and varieties of *Salix*. Almost every plant in the collection was infested. The infestation varied somewhat in severity among the various plants, but this variation could not be attributed to any varietal difference. It was usually worse on the young plants. The geographical distribution of the origin of these plants is as follows:

25 species and varieties native to Europe:

11 species and varieties native to Europe and Northern Asia.

8 species and varieties native to China.

3 species and varieties native to Asia.

3 species and varieties native to Japan.

3 species and varieties native to North America.

The chances are that this species will attack all of our native species of *Salix* and all the introduced ornamental species and that eventually it will become distributed throughout the country wherever willows are grown, unless measures for its control are undertaken now when it is limited to a small area in Eastern Massachusetts.

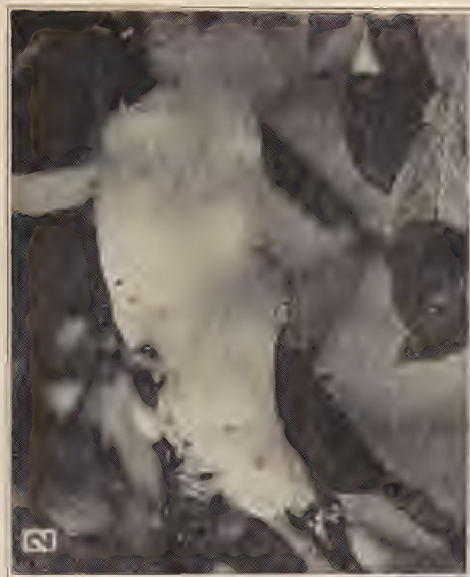
Preliminary observations indicate that this spittle bug may be controlled by hydrated lime dust containing 4 to 6 per cent of nicotine sulphate applied to the spittle masses.

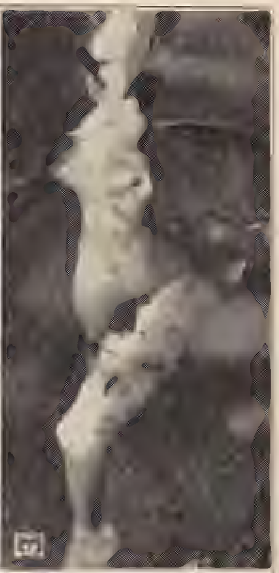
DESCRIPTION OF PLATE I.

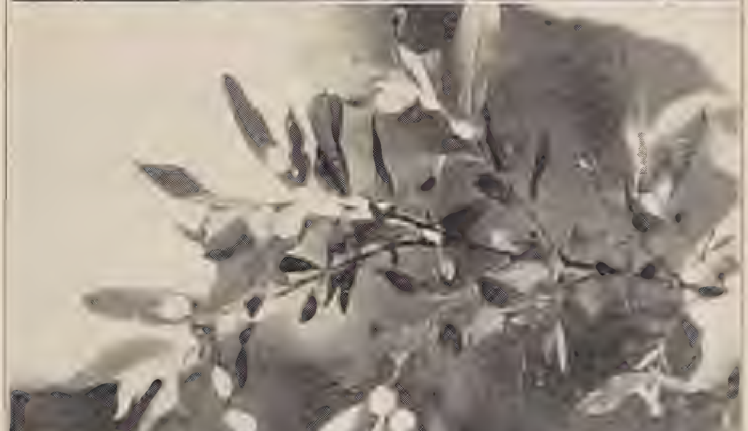
Figure 1, Twig of willow tree showing mature nymphs in individual masses of spittle.

Figure 2, Large mass of spittle containing many nymphs.

Figure 3, Same as Figure 2, not so much enlarged.







METCALF AND BARBER—APHROPHORA SALICIS

PROCEEDINGS OF THE CAMBRIDGE ENTOMOLIGAL CLUB.

Ten meetings were held in 1928, including one special meeting in September. The programs were as follows: Jan. 10: Dr. O. E. Plath, "Bumblebees, their Life History, Habits and Economic Importance." Feb. 13: Professor J. C. Bradley, "Scoliidae, with Particular Reference to the Development of Antigeny of Some Species." March 13: Dr. George Salt, "A Year in Colombia, South America." April 10, Mr. J. H. Emerton, "Notes on Spiders Collected in 1927"; and Mr. A. P. Morse, C. W. Johnson, and C. A. Frost, "The Distribution of Insects in New England." May 8, Mr. S. M. Dohanian, "Eighteen Months in Europe." June 12, Dr. J. Bequeart, "Vespidæ of the West Indies." September 11, Summer collecting notes. October 9, Mr. W. J. Clench, "Collecting Experiences in Cuba." November 13, Dr. George Salt, "Strepsiptera." December 11, Dr. F. M. Carpenter, "The Fossil Ants of North America."

Eleven new members were elected during 1928, bringing the total membership to ninety-one.

J. W. Wilson, *Secretary.*

THE UNEXPECTED ACID TEST.

While wandering along the banks of the Shawsheen River in Andover, Mass., one pleasant spring day I found a specimen of *Carabus vinctus* Web. under a piece of board. I at one pounced upon it as a prize, for at that time I had taken but few of them, and brought it closer to my face for another gloating look. As I did so I experienced the sensation that might have been caused by half a dozen red-hot needles striking my face, and at once lost all interest in the beetle until I had wiped my face with alcohol and stopped the painful smarting. I then investigated and came to the conclusion that the pressure of my thumb and finger had caused the apices of the elytra to impinge one against the other and, acting like a released spring, threw the acid secretion from the beetle into the air eight inches or more. I was greatly surprised at the strength of this acid and would fear rather severe results if it should enter the eyes.

C. A. Frost.

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